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THE EFFECT OF LENGTH OF DORMANT PERIOD UPON THE SUBSEQUENT FLOWERING OF THE POTATO PLANT

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A study of the literature on the flowering habits of the Irish potato shows that the subject has concerned many workers. No one experiment conducted so far seems to have found the answer to all the questions involved. From the work reported to date, temperature and length of day seem to be the chief contributing factors to flower development. Garner and Allard (1), growing potatoes at high temperature, found that blooming was increased by shortening the day from eighteen to fourteen hours. In more recent studies Werner (2) found that with plants grown at a high temperature (72°-92° F.) and with long days (14-15 hours) of increasing length, large clusters of completely developed flowers terminated the main axis about 30 days after emergence. He further states that length of day, rather than the inorganic nitrogen supply or temperature, was the factor dominating flower development.

It is evident from work done by a number of other investigators, not cited here, and from preliminary studies which will be presented in this paper, that there are a large number of factors contributing to flower production of the potato.

With the Triumph variety, it has been observed for a number of years that plants produced from a fall-grown Louisiana seed developed an abundant supply of blossoms, whereas seed of the same variety which had been grown in the north but planted and treated in the same manner as the fall-grown seed, produced few to no flowers.

In connection with a storage study in 1934 using a number of varieties and varying lengths of dormancy, it was further observed that with all varieties, the plants grown from potatoes having a short dormant period produced an abundant supply of flowers, whereas

plants grown from potatoes having a long dormant period produced few to no flowers.

Since varying lengths of dormancy had the same effect upon the other varieties as it had upon the Triumph, an experiment was conducted for the purpose of making a more complete study for the spring crop of 1935.

Four varieties were used in this test: the Triumph and the Warba, which are early-maturing and shy in flower production, and the Katahdin and U. S. D. A. seedling No. 44639 (Houma), which are medium to late in maturing and produce flowers in abundance.

Sufficient quantities of seed of the Louisiana 1934 spring crop of each of these four varieties were placed in cold storage and held at 40° F. New northern seed of the 1934 crop of each variety was obtained. Seed from the Louisiana fall crop which was harvested on November 22 and stored at 70° F. were also used. The length of dormancy (time from harvest to the time of planting) from the three lots of seed used, was as follows: Louisiana spring-grown—9 months and 4 days; Northern grown—5 months and 2 days; Louisiana fall-grown—3 months.

On February 22, 1935, one hundred and twelve hills of each variety and of each treatment were planted. The fertilizer and cultural methods were the same for all varieties and treatments and all varieties and treatments germinated within ten days. The Louisiana spring-grown seed require from twenty to thirty-five days for germination; northern seed twenty-five to thirty; and the Louisiana fall-grown seed thirty to thirty-five days.

In table 1 are shown the number of hills from which data were collected, the number of stalks per hill the percentage of stalks producing flowers, and the number of flowers to the cluster from each variety and treatment used.

The data in table 1 show a significant difference within a variety or varieties which have been subjected to dormant periods of different lengths. It is interesting to note that all the varieties of the Louisiana spring-grown seed, which had had the longest dormant period, produced the smallest percentage of stalks producing flowers. With one exception only, the reverse can be said of the Louisiana fall-grown seed; that is, the highest percentage of flower-producing stalks was produced by the Louisiana fall-grown seed which had a dormant period of three months.

The percentage of stalks producing flowers from the northern grown seed, which had a five-month dormant period, was intermediate between the Louisiana spring-grown and Louisiana fall-grown stock.

THE EFFECT OF LENGTH OF DORMANT PERIOD UPON THE SUBSEQUENT FLOWERING OF THE POTATO PLANT

TABLE 1.—*Effect of length of dormancy upon stalk and flower production of the Triumph, Warba, Katahdin, and U. S. D. A. Seedling No. 44639 potato varieties*

Seed Source	Period of Dormancy		Number of Hills					Number of Stalks Per Hill					Percentage of Stalks Producing Flowers					Number of Flowers Per Cluster				
	Mos.	Days	T*	W	K	S	Av.	T	W	K	S	Av.	T	W	K	S	Av.	T	W	K	S	Av.
La. Spring Grown	9	4	104	89	96	81	92	2.8	3.4	3.3	3.3	3.2	7	4	54	63	32	5.3	2.9	9.2	6.5	5.6
Northern Grown	5	2	94	100	101	111	101	1.6	2.7	1.8	1.9	2.0	17	16	80	128	60	5.9	5.4	10.2	8.4	5.9
La. Fall Grown	3	0	100	70	80	71	80	1.3	1.2	1.4	1.4	1.3	30	21	77	225	88	6.4	5.5	11.7	8.0	7.9

*T—Triumph. W—Warba. K—Katahdin. S—U. S. D. A. Seedling No. 44639.

It should be noted that the Warba and Triumph produced a smaller percentage of flowers to each stalk than did the Katahdin and seedling No. 44639. It is also of interest to observe that seedling No. 44639 produced the highest percentage of flowers to the stalk. The new seed from the north and from the Louisiana fall-grown seed produced stalks which developed, in most instances, more than one flower cluster per stalk. On a number of single stalks as many as three flower clusters developed.

It can be further observed that the number of flowers to each cluster varied in approximately the same manner, but to a less degree, as did the percentage of stalks producing flowers between the different seed treatments.

Some additional data showing the number of stalks to each hill from the different seed treatments are presented in table 1. It was found that the longer the dormant period the greater the number of stalks to the hill. This resulted in an increased number of tubers to each hill, which, as a rule, were smaller than the tubers produced from plants grown from seed subjected to a shorter period of dormancy but which developed a smaller number of larger tubers.

The plants grown from seed subjected to a long dormant period germinated rapidly, were less vegetative, more prostrate in habit of growth, and matured from ten to fifteen days earlier than did those subjected to a shorter dormant period. The reverse is true of plants produced from seed which had just completed their rest period. Seed of this nature requires a longer period for germination, but develops into an upright vigorous plant which requires a longer growing period for maturity.

Discussion

Although some of the effects of length of dormancy upon growth habits are known, it is the influence of dormancy upon the flowering habit of the potato that the writer wishes to emphasize. A knowledge of how to induce shy flowering varieties, such as the Triumph, Cobbler, and Warba, to produce more flowers is of utmost importance to the plant breeder. The information presented may aid in making crosses between desirable varieties, in order to obtain seed in sufficient quantities for breeding.

LITERATURE CITED

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FURTHER FIELD EXPERIMENTS ON POTATO SCAB CONTROL IN WESTERN NEW YORK

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Potato scab control experiments have been conducted in Western New York since the spring of 1931. Part of the data obtained during the first three seasons was presented at the annual meeting of the Potato Association of America in 1933. Where considerable additional data from similar experiments have been obtained, material presented at that time is included in the accompanying summary tables.

Further investigations on the effect of seed treatment materials on potato scab have yielded data in agreement with those presented two years ago. No attempt has been made to summarize treatments where only a few comparisons were available. The data presented in table 1 are indicative of the results obtained with different types of seed treatment materials as given in 1933. Since different fields are involved, only the direct comparisons shown should be considered in reaching conclusions from this table. Table 2 is a summary of five years' data on the effect of seed treatments, and includes the material in table 1.

Table 1 shows that in a total of sixty-two comparisons hot mercuric chloride gave 14.0 per cent more scabbed tubers than did hot formalin. This difference is apparently very significant since its Standard Error is only 2.3 per cent. When table 2 is examined we see that with additional comparisons bringing the total to 115, the mean difference between these treatments is changed to a very slight extent, lying at 12.6 per cent.

During the past two seasons we have used 8 per cent formaldehyde dust in a number of trials. The dust was prepared at this Station using uncalcined diatomaceous earth as the carrier. Results indicate that it is equally as effective as hot formalin in the control of tuber defects. It has, however, given very variable results on stand and yield. In some cases yield increases were obtained, but in many instances marked reduction in stand followed the use of this treatment. Less injury apparently occurs when the seed pieces are planted immediately after treatment than when planting is delayed two to three hours. Delay is usually more harmful on warm than on cool days. We are continuing investigations on this treatment

TABLE 1—*Effect of seed treatment on the control of potato scab—* 1931-1933

	Increase in Per Cent Scabbed Tubers				
	Hot $HgCl_2$ over	Cold $HgCl_2$ over	HgO over	HgO+ CHOH 1-60 over	Check over
Hot CHOH	62** 14.0±2.3*	14 18.2±3.5	14 20.8±6.9	28 20.8±4.5	74 5.6±2.8
Cold CHOH	22 14.9±2.8	26 14.5±4.0	30 20.3±3.3	16 15.8±0.4	34 11.0±2.8
Hot $HgCl_2$		14 1.4±0.1	29 4.2±2.2	28 4.8±0.4	85 —9.1±1.9
Cold $HgCl_2$			22 3.6±2.1	16 —2.4±5.1	26 —3.6±1.4
HgO				31 —10.1±2.8	60 —6.6±3.4
HgO+CHOH 1-60					51 —6.6±6.0

*Standard Error. Any difference greater than twice its Standard Error is probably significant.
**Number of comparisons.
CHOH—Formalin.
$HgCl_2$—Mercuric chloride.
HgO—Mercuric Oxide.

TABLE 2—*Effect of seed treatment on the control of potato scab—* 1931-1935

	Increase in Per Cent Scabbed Tubers			
	8 Per Cent CHOH Dust over	Hot $HgCl_2$ over	HgO over	Check over
Hot CHOH...	53** —0.4±1.2*	115 12.6±2.5	18 19.1±4.9	131 5.0±1.6
8 Per Cent CHOH Dust		53 11.3±4.0	4 9.3±7.8	61 4.4±1.4
Hot $HgCl_2$.....			29 4.2±2.2	138 —8.2±1.0
HgO				64 —6.9±3.2

*Standard Error of Difference. Any difference greater than twice this value is probably significant.
**Number of direct comparisons.
CHOH—Formalin.
$HgCl_2$—Mercuric chloride.
HgO—Mercuric oxide.

but, as yet, are not in a position to recommend it for use in New York State.

In general the formalin treatments gave significant reductions in scab when compared with the untreated lots. As previously reported, all mercurials increased scab as compared with the untreated checks and the formalin treatments.

Mercurials, when added to the soil, have increased scab in this district. During the past season opportunity was afforded to test the mercurial D-1, sent to us by Dr. Daines of New Jersey. Tests in three fields showed no significant difference between this material and yellow oxide of mercury, both materials markedly increasing scab as compared with the untreated check plots.

An interaction experiment was conducted in one field in 1935. In this field the effect of sulfur was studied when accompanied by sulfate of ammonia or nitrate of soda in the fertilizer and by hot formalin, hot mercuric chloride, 8 per cent formaldehyde dust or no seed treatment. This field was planned so that equal numbers of each combination existed. For example, there were four plots receiving hot formalin seed treatment, sulfate of ammonia fertilizer and sulfur. Therefore thirty-two comparisons were available when sulfur was compared with no sulfur or sulfate with nitrate by disregarding other factors. When, as has been done in table 3, the sulfur fertilizer effect has been combined to obtain the cumulative effect of these, only sixteen comparisons of each are available. As there were no significant differences between the seed treatments in any class of defects they are omitted from these data. Unfortunately, the sample from one

Table 3—Sulfur—Fertilizer—Seed treatment experiment—1935

Fertilizer Sulfur No. Comparisons	Sulfate + 16*	Sulfate — 15**	Nitrate + 16	Nitrate — 16	Sign. Diff. 100 : 1 15 x 16
Per cent tubers:					
Clean	39.6	35.3	13.6	11.8	9.9
Scabbed—					
Slight	35.3	36.0	31.4	26.1	7.4
Moderate..	11.4	15.8	37.4	41.9	11.8
Severe	0.3	0.7	2.9	8.6	5.1
Total	47.1	52.5	71.7	76.6	13.7
Culls	2.4	4.9	15.8	23.1	8.5

*Includes four each of hot formalin, hot mercuric chloride, 8 per cent formaldehyde dust and check.
**As above, only three plots of formaldehyde dust.

plot of 8 per cent formaldehyde dust, no sulfur sulfate, was lost so that only fifteen comparisons are available when one or more of these factors is in the combination studied. As a result of this the significant values presented for odds of 100:1 are for the 15 x 16 comparisons and would be slightly lower where pairings of 16 comparisons each are considered.

Rather strikingly significant differences in scab were found in favor of sulfate of ammonia over nitrate of soda as a fertilizer. These differences are in agreement with those in previous unreported experiments. Sulfur at the rate of 600 pounds to the acre had less effect than is usually obtained in this district. None of the differences between the sulfured and the unsulfured plots was significant.

Tetrachloroethane and hexamethylenetetramine were tested in one field each in 1934. The suggestions of the company supplying these chemicals were followed in making applications to the soil. No significant reductions in scab were obtained with either of these chemicals.

The effect of date of planting has been rather frequently discussed in the literature. An experiment of this type was conducted in 1934, and the data from this field are presented in table 4. These data indicate that in 1934 there was a reduction in severity of scab as the planting date was delayed.

Variety tests have been conducted each year since 1932 in soils heavily infested with the potato scab organism. A total of nineteen varieties has been tested for at least one year. In the accompanying

Table 4—Date of planting experiment—1934

Variety—Robson

Seedling (Smooth Rural type)

	Planting Date							
	May 15	May 22	June 1	June 8	June 15	June 22	July 1	Diff. Prob. Sign.*
Per cent tubers:								
Clean	23.5	22.3	31.3	32.8	31.0	35.3	57.8	15.5
Scabbed—								
Slight	44.3	48.3	46.0	48.0	51.5	56.3	37.8	11.6
Moderate	28.8	23.8	18.8	16.3	16.3	8.8	1.8	12.8
Severe	2.0	2.5	1.3	1.5	0.8	0.0	0.0	none
Total	75.0	74.5	66.0	65.8	68.5	65.0	39.5	14.4
Bearing Rhizoc. Sclerotia	25.5	33.0	25.5	15.3	16.0	14.5	24.8	none

*Difference significant at 20:1 odds.

table varieties on which no additional data have been obtained since 1933 or which have only been tested one year are not included.

In table 5 is indicated the number of years varieties have been tested as well as the total number of plots of each variety. Experiments were conducted in two fields in 1935 increasing the number of comparisons for varieties appearing in both fields this year. The varieties are arranged according to the total percentage of moderate and severe scab. The Standard Error of the difference between each variety and Russet Rural is indicated. Russet Rural is used as the standard of comparison, since it is the most resistant variety occurring in all fields and is a standard commercial variety in this region. It is

Table 5—Varietal susceptibility to potato scab

Western New York—1932-1935

All Differences Expressed in Percentage Scab over That on Russet Rural

Variety	No. Years	No. Comp.	Moderate + Severe Scab	Total Scab
Netted Gem	3	27	—11.4± 3.30*	—12.1± 6.15
Pioneer Rural	2	21	4.4± 1.37	6.8± 1.90
Robson Seedling	2	16	8.6± 5.50	9.5± 4.40
White B. Cobbler	4	32	11.9± 1.97	16.5± 6.44
Seedling 44537	2	21	11.8±11.70	4.6±18.91
Heavyweight	3	27	22.2± 6.36	11.5± 1.89
No. 9	4	32	22.7± 5.27	12.4± 2.75
Columbia Russet	2	21	32.4± 7.43	23.9±13.46
Irish Cobbler	4	32	41.5± 2.62	25.8± 7.48

*Standard Error of Difference.

emphasized that except where equal numbers of years and plots are involved the values presented may not be compared directly with one another since they are affected by varying scab infestation in different fields.

These tests have indicated that the Netted Gem, or Russet Burbank, variety possesses a considerable degree of resistance to scab. Pioneer Rural and Robson Seedling have, in comparable tests, shown a small, though not significant, decrease in scab under No. 9 and Heavyweight, the Smooth Rural varieties commonly grown in this state. White Blossom Cobbler has consistently shown less scab than Irish Cobbler.

SUMMARY

All data have been obtained from experiments in a region characterized by soils of rather alkaline reaction, usually at least pH 6.0.

Formalin seed treatments have consistently given small reductions in potato scab when compared with the untreated check plots.

Mercurial seed treatments have given small but significant increases in scab over the checks and formalin treatments.

Mercurials added to the soil have, in all cases, increased scab.

In Western New York tuber defects are markedly decreased by the use of sulfate of ammonia in the fertilizer.

In limited trials tetrachloroethane and hexamethylenetetramine showed no promise of scab control.

Netted Gem possesses a rather high degree of resistance to serious injury by potato scab.

Slight differences in scab resistance apparently exist within the Smooth Rural group of varieties.

White Blossom Cobbler is considerably more resistant than is the Irish Cobbler variety.

MORPHOLOGICAL RESPONSE OF THE POTATO (Solanum tuberosum) to ABRUPT ENVIRONMENTAL CHANGES

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Reports of controlled experiments dealing with the specific effect upon the potato plant of changes in either or both photoperiod and temperature are few and fragmentary (1, 2, 3). Therefore, groups of Triumph potato plants growing under each of four conditions in the greenhouse at Lincoln, were shifted to each of the other conditions on the 52nd day after emergence or continued in the original environment. The "short day" plants were grown with the normal winter and spring days, which were 9¼ hours long at emergence time in mid-December and 13¼ hours by mid-April when most plants were either mature or maturing rapidly. For "long days" the normal day length was prolonged to 21 hours with 60 watt electric bulbs kept 2 feet above the plants and 3 feet apart. This was adequate for the tops of plants but the lower parts of the plants were not so well illuminated

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TABLE 1.—*Performance of potato plants when temperature and day length were not altered.*

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Temperature and Day Length for Entire Period	Dry Weight of Tubers in Grams per Plant			Per Cent of Dry Matter in Tubers			Number of Tubers per Plant[1]			Dry Weight of Tops in Grams per Plant			Ratio of Dry Weight of Tubers to Tops			Days to Mature
	52nd Day	70th Day	When Ripe	52nd Day	70th Day	When Ripe	52nd Day	70th Day	When Ripe	52nd Day	70th Day	When Ripe	52nd Day	70th Day	When Ripe	
Cool-short	17.5	32.1	62.0	14.4	13.4	17.4	3–9	6–9	4–4	11.4	10.4	12.0	0.7	3.1	5.2	105
Cool-long	4.4	27.2	84.6	12.8	15.2	15.1	4–30	4–19	13–26	15.7	22.7	24.6	0.3	1.2	3.4	131
Warm-short	2.4	4.2	1.4	10.3	10.8	11.6	4–8	2–17	2–2	11.0	16.1	13.7	0.2	0.3	0.1	94
Warm-long	0	0	0	0	0	0	0	0	0	10.9	26.1	40.3	0	0	0	113

[1] First figure indicates number of tubers weighing over 1 gram; second figure, total number. (454 grams per pound).

TABLE 2.—*Performance of plants when temperature or day length was altered on the 52nd day.*

Temperature and Day Length to Which Plants Were Subjected up to and after the 52nd Day	Dry Weight of Tubers—Gms. per Plant		Per Cent Dry Matter in Tubers		Number of Tubers per Plant[1]		Dry Weight of Tops—Gms. per Plant		Ratio of Dry Weight of Tubers to Tops		Days to Mature
	70th Day	When Mature	70th Day	When Mature	70th Day	When Mature	70th Day	When Mature	70th Day	When Mature	
Cool-short to cool-long	35.1	112.2	15.8	16.9	4–4	7–13	9.3	9.2	3.76	12.2	114
Cool-long to cool-short	25.5	67.1	13.4	14.5	3–11	15–88	22.3	17.3	1.14	3.9	125
Warm-long to cool-long	13.9	85.1	13.9	16.3	5–16	9–22	25.4	15.7	0.05	3.3	135
Cool-long to warm-long	5.8	.01	11.1	?	4–11	0–5	27.5	51.2	0.21	.013	115
Warm-long to cool-short	6.9	64.1[2]	12.7	16.4[2]	16–48	10–13[2]	32.4	12.9[2]	0.21	5.0[2]	127[2]
Cool-short to warm-long	24.1	19.7	13.8	12.7	6–15	4–11	10.7	9.0	2.27	2.2	94
Warm short to cool-short	15.7	49.5	13.8	13.6	2–11	30–62	16.8	15.1	0.93	3.3	114
Cool-short to warm-short	30.1	18.9	15.3	13.4	5–6	2–3	8.8	6.5	3.43	2.9	82
Warm-short to cool-long	17.6	21.3	15.6	15.5	2–15	7–12	10.1	9.8	1.75	2.2	125
Cool-long to warm-short	13.8	2.4	12.7	23.4	5–20	2–5	33.2	13.9	0.42	0.2	100
Warm-long to warm short	.01	0	?	0	0–1	0	27.3	7.9	.004	0	98
Warm short to warm-long	6.3	?	11.4	?	3–25	?	32.3	?	0.20	?	96?

[1] First figure indicates number of tubers weighing over 1 gram, second figure, total number.
[2] Plants shifted on 52nd day were not available so data from plants shifted on 67th day were used.

as might have been desirable. The low temperature was maintained quite constantly at 62° F., the high temperature at 80° F., the temperatures in both cases sometimes rising during midday from 3 to 10° F. All plants were grown in 10 inch pots in sand with a complete nutrient solution.

Fifty-two days after emergence, before any plants were transferred to other conditions, those grown with cool-short days had a few short stolons on which was produced more weight of tubers than in any other treatment, and they also had the highest tuber/top ratio (table 1 and fig. 1). Those grown during cool-long days had made the greatest vegetative growth, the most extensive stolon growth, and set the greatest number of tubers, but the weight of the tubers was only about 1/4th that of those from the cool-short day plants and the tuber-top ratio was less than half as great. With warm-short days

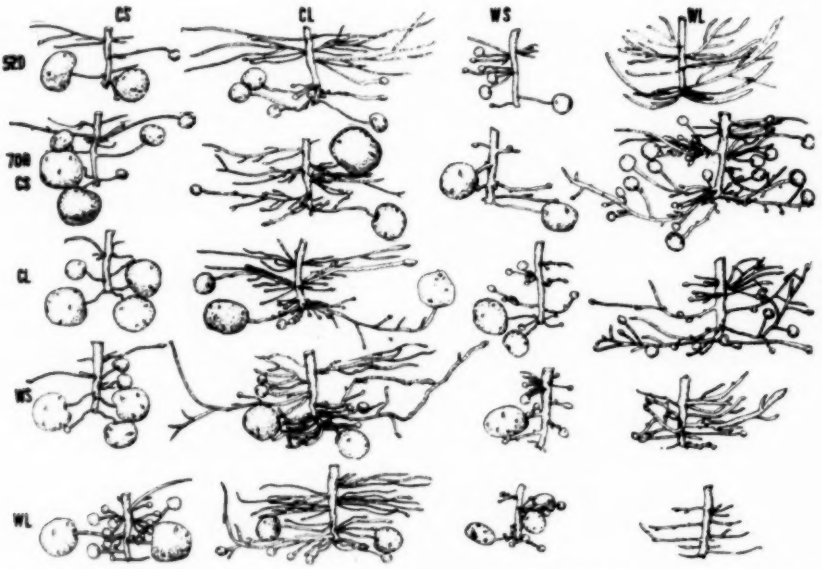

FIGURE 1.—*Type of stolon and tuber growth produced by plants subjected to various temperatures and day lengths 52 days after emergence (in top row) and 18 days later when continued under constant conditions or after having been shifted to other conditions (in lower 4 rows). Letters at top indicate conditions under which plants were held the first 52 days; letters at left (rows 2 to 5), conditions to which they were subjected from the 52nd to 70th days. Therefore the second plant from the left in the second row from top was transferred from cool-long to cool-short days, the third plant in the row from warm-short to cool-short, etc. (C-cool, W-warm, S-short day, L-long day.) Plants diagonally across from the first plant in second row to last plant at right in lower row were continued under the original conditions. The portions of the main stems shown ranged from ten to twelve centimeters in length.*

vegetative growth totalled about as much as with cool-short days, but the ratio of leaves to stems was less, as the leaves were small. Stolon growth was limited and the weight of tubers was less than with cool-long days. With warm-long days the vegetative parts weighed least of any series, stolon growth was less extensive than at cool temperatures and no tuberization of any kind had occurred. The low vegetative weight was probably caused by rotting of the seed pieces at high temperatures. This resulted in a delay in the plants becoming established.

At the end of eighteen days, the plants that had been kept in their original environment, and subjected to cool-short days still led in tuber production and gave the highest tuber/top ratio. Those exposed to cool-long days had very large tops, the most stolons, greatest number of tubers and highest dry matter content in tubers. But, although tuber weight had increased six-fold, the tuber dry weight and the tuber/top ratio were still below those of cool-short day plants. The warm-short day plants had increased almost 50 per cent in vegetative parts and tubers—the increase in the tuber/top ratio being very slight. With warm long days vegetative growth had been greatly accelerated so that now these parts weighed more than with any other constant treatment but no tuberization had occurred.

Total vegetative growth was eventually increased mostly because of long days but also considerably by high temperatures. The final number and weight of tubers at maturity were greatest with cool-long days in which plants lived longest; but the highest tuber/top ratio and dry matter content in tubers occurred with cool-short days. With warm-short days there was a loss in tuber weight after the seventieth day. Plants grown during warm-long days produced the largest tops but no tubers.

Plants kept continually in the same environment lived longest at low temperatures and with long days, whereas those grown in warm-short days were the shortest lived. Transferring to lower temperature, regardless of day length, prolonged the life; and transfers to higher temperatures, regardless of day length, shortened the life of plants (table 2). Transfers from long to short days at the same temperature shortened the life of the plant and the reverse shifts prolonged it slightly. The characteristic effect of any given condition upon the age of the plants was in evidence as a contributing factor in the duration of the lives of plants even though they were later transferred to other conditions. Temperature seems to have

been a more significant factor than day length in determining the duration of plant life.

The number of tubers was generally influenced mostly by conditions early in the life of the plants, being few in number but large, if early conditions were very favorable for tuberization. If early conditions were most favorable for vegetative growth, exceedingly large numbers of tubers were set whenever favorable conditions for tuberization were supplied. There was also some increase in number of small tubers when plants were transferred from conditions favorable for tuber enlargement to conditions more favorable to vegetative

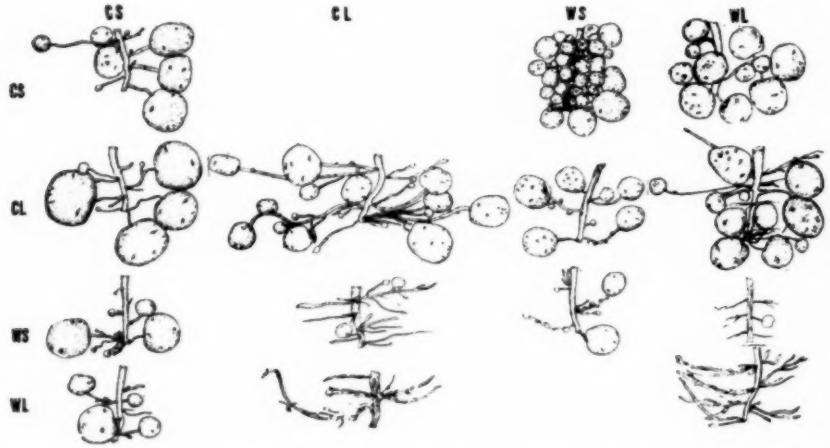

FIGURE 2.—*Type of stolon and tuber growth occurring on plants at maturity, when either continued under the original conditions or when shifted on the 52nd day to other conditions as indicated. Arrangements of plants as to treatments, same as in figure 1.*

growth, as from short-cool or even short-warm to long-warm days, but when the former carbohydrate reserves in these plants were used up these tubers were quickly resorbed.

Tuber weight was greatly increased by transferring plants from high temperatures with either long or short days to low temperatures with either day length. Plants which were already tuberous, when transferred to low temperatures from warm-short days showed an immediate increase which was greater than with the purely vegetative long-warm day plants, but with the latter the final total yields were greater (from 52 days, see table 1; to 70 days, see table 2). This was probably because of the larger tops of the latter which developed

during the first few weeks after being transferred, at which time the plants from warm-short days were forming tubers. Transfers from cool-short days to cool-long days did not increase weight of tops but accelerated tuber enlargement and resulted in heaviest final yields of tubers and a reverse shift resulted in slightly less vegetative and tuber growth. With cool temperatures, transferring plants from long to short days and vice versa resulted in a very high tuber-top ratio even though the percentage of dry matter in the tubers was lowered slightly below that of plants maintained at the original day length. Transfers from high to low temperatures resulted in increases in tuber-top ratios and also in the dry matter content of tubers, the latter tending to be highest when cool-long days occurred last.

When plants were transferred from low temperatures with either short or long days, to high temperatures of either day length, tuber enlargement continued for a few weeks, then dry matter was resorbed from the tubers. At maturity the tuber weight from plants originally subjected to cool-short days corresponded approximately to that recorded when the plants were transferred; with those formerly subjected to cool-long days the weight was actually less than when transferred, the tubers having practically disappeared as a result of being transferred to warm-long days. The dry matter content of tubers and the tuber-top ratios were both lowered.

Some tuberization occurred for a brief period after plants were transferred from long to short days at high temperatures but after a few weeks this material was resorbed. Plants that were transferred from short to long-warm days continued to form tubers quite actively for several weeks but these tubers suffered serious loss in dry matter as the plants matured.

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NOTE ON REGIONAL DISTRIBUTION OF MAGNESIUM IN RIVER AND LAKE WATERS OF THE UNITED STATES

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A chart accredited to the writer, showing the magnesium (MgO) content of surface drainage waters of the United States, was published in the American Potato Journal of April, 1933.(1) The authors, in referring to this chart, make the following comment:

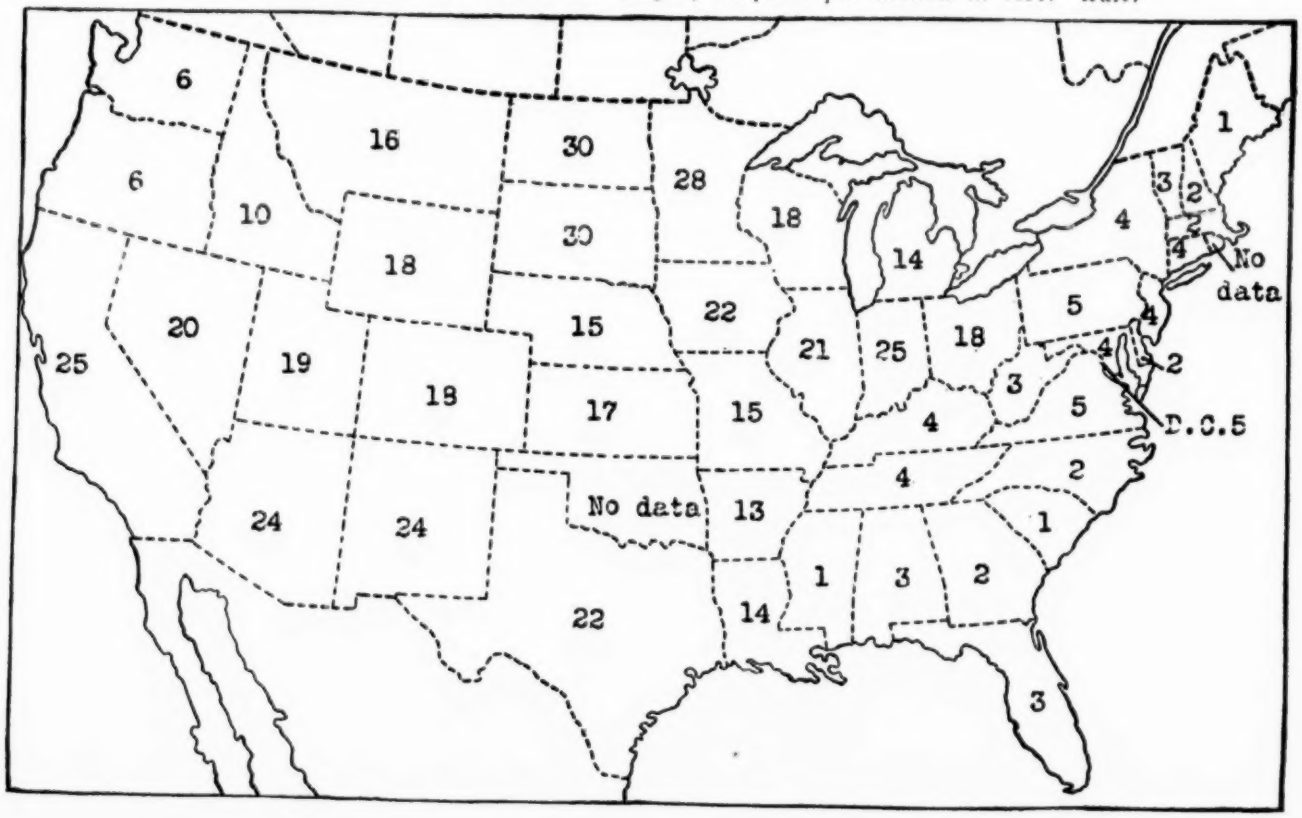
> "An interesting point connected with the chlorotic appearance of potato plants, high soil acidity and consequent leaching of basic soil compounds is brought out in studying the magnesium content of streams, both major and minor, and lakes, over wide stretches of the United States, as published by the U. S. Geological Survey. Along the Atlantic Seaboard, in the Coastal Plains Section where the soils tend to leach readily, the amount of magnesium in the water sources is much less than in other sections of the country. This suggestion serves to show that the sections where magnesium is shown to be comparatively low in streams are where magnesium soil deficiencies have been found to be most prevalent."

A second chart is presented herewith. It was prepared at the same time and from the same data as the chart previously published. Investigators may find this additional information of value, since the average number of parts per million of MgO in river and lake water is shown for each state.

These charts were developed in connection with an investigation of mortality statistics made by the writer. No correlation was observed between the distribution of magnesium, as indicated by its presence in river waters of the United States, and the distribution of deaths from the diseases studied. The charts are based on analyses published in "The Composition of River and Lake Waters of the United States" by F. W. Clarke (U. S. Geological Survey, Professional Paper No. 135; 1924). The geographical distribution of the published analyses is uneven and the periods of time for which data are available vary greatly for the different localities, so that the charts are to be considered as rough approximations rather than accurate determinations.

Both charts are based on the average figure for MgO in parts per million as published in the Geological Survey bulletin for each sta-

Chart 1.—Distribution of magnesium (MgO) in parts per million in river water



tion. In preparing the zonal chart previously published, this average figure was plotted on a large map showing the drainage systems of the United States. The plotted figures were located on the map as nearly as possible at the place where the water samples were taken. The boundaries between zones were drawn by inspection of the detailed data on the large map. All of a drainage system up stream from a station was considered as having the MgO content shown by that station, if no analyses were available to indicate differences on the various branches of the watershed. More weight was given to data for stations where analyses were made over long periods of years than for stations where only a few analyses were recorded.

Chart 1 shows that the MgO content of surface waters is lowest in the northeastern states and in the states south and east of the Ohio and lower Mississippi rivers, ranging from 1 to 5 p.p.m. Washington and Oregon have the relatively low average figure of 6 p.p.m. The waters of the Dakotas and Minnesota have the high average of 28 to 30 p.p.m. of MgO. Indiana, Illinois, Iowa, Texas, New Mexico, Arizona and California have relatively high averages, exceeding 20 p.p.m. The remaining states average 10 to 20 p.p.m., indicating average conditions of MgO content of river waters.

Confirmation of the figure for Virginia shown in Chart 1 is furnished by recently published data, (2) which were not contained in the data on which chart 1 was based. The magnesium content of water samples taken from sixteen Virginia rivers, collected daily for one year at points well distributed over the state, averaged 4.93 p.p.m. in the more recent data as compared with 5.0 p.p.m. on the chart.

Auten, (3) states, "Relative calcium and magnesium contents of forest and adjacent field soils seemed to be a good index of soil changes occurring after the cultivation of cleared forest land." He finds that soil cultivation induces increased oxidation of organic matter. The relatively rapid liberation of CO_2 hastens the solution and leaching of calcium, magnesium, and other elements in the soil. Much of the magnesium and calcium leached from the surface soil layer is absorbed in the horizons immediately below the surface soil, but part is carried off by the drainage waters. The relative calcium and magnesium content of drainage waters might provide a more representative index of soil changes than the soil sampling method used by Auten.

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PROGRESS MADE IN THE BREEDING PROGRAM IN MICHIGAN IN 1935

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The potato seedling work was started in Michigan in 1923, when several seedlings from Irish Cobbler and Green Mountain varieties were grown. None of these seedlings was superior to any of the commercial varieties then grown in Michigan. The last of these seedlings was discarded in 1929.

In 1929 the Michigan Agricultural Experiment Station entered in a co-operative agreement with the Horticultural Section of the Bureau of Plant Industry. The Katahdin and several other seedlings were grown at the Lake City Potato Experiment Station, Lake City, Michigan. Potato breeding activities in Michigan may be grouped under the following broad topics:

(1) Production of parent breeding stock by using seedling and variety cross and selection within selfed lines.

(2) Breeding new seedlings for disease resistance with special reference to the mosaics, yellow dwarf and common scab.

(3) Development of seedlings resistant to hollow heart, off-type and second growth.

(4) Development of a medium maturing seedling adapted to muck soils.

(5) Cooking tests of more promising seedlings.

Michigan potato growers face the situation of not being able to produce enough prime potatoes to the acre to make the industry profitable. The soil is becoming badly infested with the scab organisms, making the growing of white skin varieties impossible.

The climate of Michigan varies from good corn-growing climate in the southern tier of counties to the most favorable climate for potatoes in the Upper Peninsula. The southern part of the lower Peninsula is frequently dry and hot during July and August, with sufficient moisture in September to produce an abundance of hollow heart and off-type tubers.

The Irish Cobbler variety is grown in all sections of the state, whereas production of the Russet Rural is confined to the southern part of the Upper Peninsula and generally grown in all parts of the Lower Peninsula. The Russet Rural variety is fairly scab-resistant, but because of the conditions under which it is grown, it is becoming less favored by the consumers in the cities. The growers plant late, harvest immature tubers that are soggy, and which frequently turn black soon after boiling. Under ideal potato growing conditions, the Russet Rural is a desirable potato. The White Rural has all the disadvantages of the Russet Rural with one addition, that is, it will scab more frequently. The Green Mountain variety is grown principally in the Upper Peninsula along the southern shore of Lake Superior. Other standard varieties are grown by a few growers, but are not of any commercial importance.

Mosaic is giving the Green Mountain growers a disease problem. Potato yellow dwarf developed to an epidemic stage during the seasons of 1931 and 1932, but it has been decreasing during the past two years. Many county agents urged their growers to purchase new seed from yellow dwarf-free fields in other sections. These fields were inspected by representatives from the College and recommended to the County Agents. This new seed has made it possible to reduce other virus diseases. Most of the seed recommended was from growers who had certified seed or had planted their field with certified seed for a period of one or two years.

Late blight is not a serious problem with Michigan potato growers. When it does occur it is only in a few scattered fields in isolated areas.

Where Potato Breeding Experiments Are Being Conducted

Because of the variation in climatic conditions in Michigan, several sub-experiment stations have been established in various parts of the state. The main experiment station is located at the Michigan State College, East Lansing, Michigan. Sub-experiment stations are located at Battle Creek in the south-western part of the state, and at Lake City in the central part of the northern portion of the Lower Peninsula and the Chatham station, located in the Upper Peninsula. In addition, breeding studies are being conducted on two farms. One is located at Rogers City in the northeastern part of the Lower Peninsula, and the other farm station is located at Munising in the Upper Peninsula.

Desirable Characters in a New Variety

Michigan growers are asking for a new white-skinned variety that will replace the Russet Rural. The ideal variety for Michigan should be medium in maturity, white smooth skin, shallow-eyed, free from second growth and hollow heart, resistant to virus diseases and common scab.

Progress Made in 1935

Hybridization

Several good crosses were obtained between good vigorous seedlings, seedlings resistant to scab, yellow dwarf and inbred lines. Considerable seed was obtained and will be grown in the greenhouse in 1936.

Scab Tests

Approximately thirty scab-free seedlings were selected at Chatham. Other seedlings adjacent to the hills free from this disease were covered with scab lesions, and the hills selected showed scab-free tubers. These seedlings will be increased next year with several other older selections.

Yellow Dwarf Plug Grafting

This year one hundred and forty-four seedlings were plug-grafted with yellow dwarf. Results indicate that certain seedlings show resistance to this disease. Additional inoculations will be made next year to further test these seedlings for yellow dwarf resistance.

Testing of New Varieties

The Katahdin has been tested in Michigan for seven years. In 1935, several thousand acres were grown. Reports from many of these growers indicate that it is a fair variety, and adapted to the lighter soils. Many of the growers have used the Katahdin to replace the Russet Rurals. Seed of the Katahdin has been scarce, consequently many growers plant too far apart, resulting in production of oversized tubers. When Katahdins are grown on the heavier soils the farmers have reported the presence of too much scab. The production of a high percentage of the U. S. No. 1 potato in Katahdins has been reported by many growers. Inquiries for seed are being sent in to the office, which indicate that there is a demand for this new variety. Nearly all growers report the Katahdin as being a variety producing excellent type tubers under adverse climatic conditions.

The Chippewa has not been generally introduced by the Michigan potato growers. Fifteen growers located in different sections of the state report very favorably on this new variety. All these

growers are increasing their supply and no doubt it will be released in 1936 to the commercial growers. Many of the growers who grow both Katahdin and Chippewa, prefer the Chippewa.

Seedlings Adapted to Muck Soils

In 1933 approximately 150 seedlings were grown on muck at East Lansing. Twenty-five seedlings were selected in 1933 for increase in 1934. The seedlings saved were selected because of the following qualities: (1) tubers should set close under the hill; (2) tubers must be set fairly deep to prevent sun burning; (3) must be early or medium maturing; (4) and should be shallow-eyed with ability to resist the clinging of muck to the tuber.

In 1935, yields of two seedlings produced approximately one thousand bushels to each acre with a U. S. No. 1 yield of eight hundred bushels to the acre. All seedlings gave yields of three hundred or more bushels to the acre of U. S. No. 1 potatoes.

Cooking Tests

At the present time cooking tests have not been made with the 1935 seedlings. Approximately forty-five promising seedlings are to be boiled to determine their cooking quality. Many of these seedlings have been grown at all the sub-experiment stations.

Hotel and Restaurant Tests with the Katahdin Variety

Sixty-seven bushel lots of Katahdin potatoes were sent to hotels and restaurants. Reports have been received from fifty-seven lots. The main criticisms of these potatoes were, that after standing for a few minutes, they turned dark in color. For baking they seemed to contain too much water, and were reported as being too soggy for general hotel and restaurant use.

Eleven reports indicated that the potatoes turned black after standing fifteen minutes; twenty-one found them good for baking; forty, for boiling; forty-one, frying, and thirty-three reported them good for mashing.

The Katahdins sent to the hotels and restaurants were grown at Lake City. Most of the chefs were comparing the Katahdins with highest grade potatoes obtainable in their city. In such tests forty-six of the fifty-eight hotels and restaurants reported the Katahdin satisfactory. Many have inquired where Katahdins may be purchased.

In summarizing all these reports there is strong evidence that the Katahdin variety grown in Michigan will satisfy the demands of the better class of trade.

SECTIONAL NOTES

IDAHO

It is still early to give any definite information on the 1936 Idaho potato crop. The general situation tends toward a slight increase in acreage.

Prices for commercial potatoes were fair during the winter and of course, as everywhere else, the prices this spring after most of the stock was gone were abnormally high, all of which tends to stimulate interest in planting. Weather conditions also are favorable in that the water supply is the best it has been for the past several years, and recent rains have put the soil in excellent condition for favoring plant growth.

Nearly all our growers plant during June; that is, the main crop. The crop planted for early market is in excellent condition. However, the acreage as compared with the late planting will not influence the total output to a very great extent. A few growers plant in May, but more of them have learned that mid-season planting is likely to cause tuber formation at a time of excessive heat, which is always disastrous to our Netted Gem potato in that any checked growth generally results in distorted, ill-shaped stock. Our growers have to decide whether they will sacrifice a percentage of yield by late planting, or plant earlier and risk the procuring of No. 2 stock. Of the two alternatives, the stock planted from early to late June (depending on the altitude) has the greater percentage of really successful crops. (June 10).—E. R. Bennett.

MASSACHUSETTS

The potato crop is proceeding normally with approximately the same acreage planted as last year. Because of cold, wet weather, and flood conditions in part of the Connecticut Valley area, early planting was delayed. However, with drier weather, planting proceeded rapidly and at this date the majority of the plants have germinated.

Drier conditions the past month have retarded development to a certain extent. Spraying operations are being conducted on some of the earlier planted crops. Growers are fairly optimistic concerning favorable market prospects. (June 9).—Ralph W. Donaldson.

MINNESOTA

During the month of April it appeared as though all farming operations would be delayed at least two or three weeks, particularly in the

northern half of the state. Cold weather and heavy snowfall during the latter part of the winter, even into April, in some regions, prevented farmers from getting into the fields as early as they usually do. However, the month of May was ideal in every respect, and the delay in field operations caused by the unfavorable April weather was soon made up during the first two weeks in May.

Potato planting in the sand land area was delayed about a week, but the excellent growing conditions in May resulted in the production of very good vine growth. Owing to the extremely cold weather and heavy snows, planting on the peat bogs was delayed somewhat longer because of the fact that frost remained until the middle of May in some cases, and therefore interfered with drainage. Planting in the Arrowhead section and in the Red River Valley has proceeded normally and is practically completed at this date.

Considerable interest in the Warba and Chippewa varieties this spring has been manifested, as is indicated by the large number of inquiries for seed stock of these varieties. Although a large supply of certified Warbas was available, the supply of Chippewas was very limited. The Chippewa has proved to be an excellent medium early variety in the northern half of the state, and we anticipate a considerable increase in applications for inspection of this variety this year.—(June 10)—A. G. Tolaas.

NEBRASKA

The crop situation, particularly from the standpoint of moisture, has changed materially in Nebraska since June 1. After several days of threatening skies, which usually resulted in nothing but wind, Mother Nature took pity on western Nebraska farmers and the much-needed rains began to fall. These rains continued over various parts of the state for approximately a week, falling in slow, gentle showers, totalling from .25 to as much as an inch each day in some places. The precipitation now totals about two and one-half inches for this week of rainfall.

Although the grain and corn crops were badly in need of rain, well-cared-for potato seed beds could have waited for some time before rain was needed. The conditions are ideal now for all potato planting, which has been launched in earnest since the beginning of the second week of June.

Planting indications show that approximately the same acreage will be planted as in 1935, though the condition of the seed is not

so good as it was a year ago. Because of this fact, it is possible that there will be some reduction from the contemplated acreage, unless growers plant farther apart than they ordinarily do and, by so doing, spread the seed over a larger acreage.

If satisfactory seed stocks could be secured, more seed potatoes would undoubtedly be planted. As a matter of fact, practically no seed stock, of whatever quality, is available at this time.

The extension horticulturists of the Nebraska College of Agriculture have held meetings throughout the potato-producing areas to discuss spraying for the control of the potato psyllid. This insect has caused sporadic outbreaks of trouble for several years, but has been given serious consideration for only two or three seasons. Several of the larger growers have already purchased power spraying equipment, to protect their acreage this season. Several groups of smaller growers have pooled their acreages and purchased sprayers. Many fields were not dug in 1935 because of the extent of psyllid yellows, and in many other fields, both on dry land and under irrigation, the yield and quality were greatly reduced because of this trouble.

Growers in general are very optimistic over the potato situation, and there is some demand for contracting seed by southern growers for delivery this coming winter. The prices being considered are substantially higher than the season just completed. (June 11).—MARX KOEHNKE.

NEW HAMPSHIRE

Planting has practically been completed and, according to best estimates, the acreage shows an increase of approximately five per cent. The weather was cold until the middle of May when it became warm and dry. This condition continued until June 11. The weather during planting time was favorable; the group was well prepared and sufficient quantities of fertilizer were applied. Cobblers have now germinated and are in need of rain.

Old supplies of potatoes were exhausted on June 1 at which time they netted the growers $2.00 per bushel. The supply of old potatoes was shorter than any year since 1920. The supply of certified seed was also sold early.

Improved prices in the latter part of the season have materially boosted the courage and enthusiasm of the growers and there is little indication that the Soil Conservation Program has materially enticed the growers to divert from potatoes to soil conservative crops. (June 12).—DAN A. O'BRIEN.

NEW JERSEY

With no rain for several weeks the potato crop was seriously threatened, and estimates of yield reductions ranging from five to fifty per cent were made. Rain for the past several days has relieved the situation, however, and it is questionable if the crop is seriously injured. The plants are smaller than usual, but growers in several sections report a good tuber set and are much more optimistic than they were a week ago. Naturally all are interested in the price situation and see a possibility of recouping the losses of the past two years. Some digging will start by the middle of July, but there will be no general movement until the last of the month, or the first of August.

The New Jersey crop will not be sold through a Central Sales Office this year. A committee of growers will be appointed from the New Jersey State Potato Association to consult with the dealers and keep the growers informed concerning the marketing situation and other new developments. (June 15).—W. H. MARTIN.

NEW YORK

Potato planting has progressed rapidly since June 1 throughout upstate New York. Although the temperature has been too cold to promote growth of the early-planted acreage, rainfall has not interfered with planting. In fact, Western New York is in greater need of rain than is usual at this time.

Programs for two potato field days for New York are being planned. The annual field day of the Empire State Potato Club will be held on August 6 at the Claude Potter farm, in Wyoming County. David Mote of Gainesville, N. Y., who operates this farm, will be host. Last year over seven thousand attended. President Roy Porter is negotiating for a speaker of national prominence. Modern potato machinery of all kinds will be exhibited and demonstrated.

A Northern New York Potato Rally will be held at the farm of E. G. S. Gagnier, Cherubusco, Clinton County, on August 12. Mr. Gagnier is the largest grower in Northern New York and a pioneer in the production of certified seed. It was just twenty-one years ago that the first certified seed potatoes produced in New York were grown in this county. Mr. Gagnier operates a 32,000 bushel modern bank storage which in iteslf is worth seeing. County farm bureaus in nearby counties are cooperating with the chair-

man, Robert Foote of Plattsburg, to make this a real potato rally. Northern New York is the Aroostook of New York, where soil, climate, varieties, and yield are similar to those of Aroostook County, Maine. Large delegations of growers from Long Island and New Jersey are expected to attend. (June 11).—E. V. HARDENBURG.

NORTH CAROLINA

Prices are slightly lower than they were last week. Our yield will be much smaller than it was last year and it is doubtful whether North Carolina will ship as many as six thousand cars this year. The poor stands caused by the floods in the spring and the poor condition caused by the drought during the growing season have reduced the crop to at least one-third, and possibly one-half. We have had some rain during the past week but it probably came too late to help the crop. Our highest yields this year will be about sixty barrels to the acre. (June 9).—ROBERT SCHMIDT.

OHIO

There is not much change in our potato situation. The early section continues dry, but cooler weather has helped to a certain extent. Some potatoes will be dug next month, but present prospects indicate a very poor crop. (June 15).—E. B. TUSSING.

PENNSYLVANIA

Applications for seed potato certification are being received. More than six hundred acres have been entered for inspection, compared with eight hundred and eleven acres entered in 1935. A considerable increase in the acreage to be entered this year for certification is anticipated.

Last year certified seed growers reported that they could have sold much more seed than they grew. Although there is probably a slight decrease in the acreage planted to potatoes this year compared with the acreage harvested in 1935, there was a strong demand for seed. Seed potato growers are more optimistic than they have been for several years.

RHODE ISLAND

Apparently the same acreage as last year was planted by most of the larger growers. The season was favorable at first but the weather during the last four weeks is retarding growth. If the

drought continues the yield will be reduced materially. The price, at present, is the best we have experienced in a decade. Unfortunately, however, we have none of last year's surplus on hand. (June 11).—T. E. Odland.

TENNESSEE

It is nearly time for us to dig our earliest potatoes. We have had a long and severe drought period. Although the tops look fairly well, I am sure the yield will be greatly reduced. (June 8).—Brooks D. Drain.

WISCONSIN

Weather conditions in the main potato growing areas of central and upper Wisconsin continue generally favorable. Planting is nearly finished in the upper Wisconsin counties. Some planting of the late main crop is still in progress in Central Wisconsin and will continue until approximately June 20.

In general, the crop has been planted under favorable conditions. Recent timely rains will prove very beneficial to the early planting. Continued moderate weather would provide excellent early season growing conditions.

The Extension Service of the Department of Horticulture, has located a comprehensive series of seed and variety plot demonstrations again this year involving a total of five locations in the southern, central, and northern areas. Certain seed stocks representing both the old and recently introduced varieties have been assembled and are being grown under the widely varying conditions characteristic of Wisconsin potato growing areas.

In addition the Department of Horticulture has grown an increased volume of seed stocks at the Spooner Branch Station and these have been distributed in one hundred and twenty-five locations in the state. About three of the newer varieties will be grown this year on a large enough scale to give some records under actual farm producing conditions.

Schedules of state and local field tours are being planned at this time. The Wisconsin Potato Tour will be resumed again this year and will probably be held during the week from August 3 to 8 and cover the intensive certified seed growing area in the north central section of the state. (June 12).—J. G. Milward.

THE PRICE SITUATION

Prices of both old and new potatoes rose sharply during the last half of May and first week of June, but lost much of this advance during the second week of June. Normally, prices of new potatoes decline sharply during this period, but this year prices have advanced, due largely to the poor growing conditions prevailing in the second early and intermediate States this season and the shortage that developed in the supply of old stock during the late spring. At the present time the market supply of potatoes is very short, but this situation is expected to be alleviated as soon as shipments from the intermediate States begin to move in volume. The prospect is for a gradual decline in prices as the season progresses, with the rate being accelerated if the crop in the late Northern States matures early.

The production of early and intermediate potatoes probably will total 33,500,000 bushels this year compared with 38,100,000 bushels produced last year and 42,127,000 bushels the 1928-'32 average. This estimate is based upon the reported yields for the early, second early and first section of intermediate States and average yields for the second section. Production in the second early States and the first section of intermediate States, from which potatoes are now moving in considerable volume, totals 12,771,000 bushels compared with 17,231,000 last year and 23,322,000 the 1928-'32 average. The short crop indicated for these areas this year coupled with a short supply of old potatoes carried over from last season has contributed largely to the recent sharp price advance.

From January 1 up to the end of April this year, rail and boat shipments of old potatoes totalled about 75,000 cars, or only 3,000 cars below the volume moved during the corresponding period of 1934, when the January stocks of old potatoes were about the same as this year. From the end of April to the present time, however, shipments have fallen considerably below the volume moved in the same period in 1934, or to only 7,000 cars compared with 11,600. On the other hand, shipments of new potatoes have held up to almost the same volume as in 1934. This is particularly true of these shipments in the later period. The rate of shipments of old stock is rapidly decreasing now, and it is probable that only a few hundred cars remain. However, after the middle of June shipments of old potatoes are seldom very large and the trade usually shifts to the early and intermediate States for its principal source of supply. (June 15, Bureau of Agricultural Economics, United States Department of Agriculture).

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PROTECT THE CERTIFIED SEED INDUSTRY

Results of thousands of demonstrations have definitely proven the value of certified seed potatoes. As early as 1924, H. C. Moore reported on the results of more than eleven thousand tests in which the yield of certified seed potatoes averaged forty-six bushels per acre more than the non-certified seed. Since 1924, certified seed potatoes have continued to improve. Many commercial fields in the Southern states now show less than one per cent of diseased plants.

Additional efforts are necessary to produce seed potatoes and much more careful grading is also necessary to meet the grade requirements in some states. A few years ago the seed grower was compensated for these additional costs of growing certified seed. In 1926, for example, a survey revealed the fact that certified seed brought from twenty-five cents to a dollar more than table stock. In the past several years this price differential has been greatly reduced and the certified seed growers are finding it unprofitable to grow the crop.

In considering certified seed we should realize that its chief value lies in the fact that it is free from the virus diseases and others not controlled by seed treatment. Even though scab and rhizoctonia do not improve the appearance of the tuber, the presence of these fungi does not result in yield decreases if the seed is disinfected before planting. There are other tuber defects which, while objectionable from the standpoint of appearance, do not influence the vigor of the seed. We should have uniform grade standards for certified seed potatoes but we cannot afford to make them so rigid that the grower is compelled to discard a large portion of his crop in order to meet them. We should insist only on a tuber grade standard which ensures seed potatoes capable of producing a good crop. We must continue to have certified seed potatoes. The growers must be rewarded for their labor, however, if we are to have a continued supply of high-yielding seed.